The op-amp is ideal, with $V_{CC} = 10\, \text{V}$ and $V_{EE} = -10\, \text{V}$.

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
- What is $V_o$ at $t = 3.5\, \text{ms}$?

All voltages in $\text{V}$

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  Waveform at $V_+$ is an decreasing exponential, starting at $V_+ = 0.56 - 0.22 = 0.34$
  \[ \Delta t = 3.5 - 1.3 = 2.2 \]
  \[ \tau = RC = 23.4 \times 38.6 = 903.24\, \mu\text{s} = 0.90\, \text{ms} \]
  \[ V_+(3.5) = 0.34e^{-\Delta t/\tau} = 0.0295 \]

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  From $V_+$ to $V_o$ is a non-inverting amplifier of gain, $G = 1 + 47/25 = 2.88$
  Waveform at $V_o$ is an decreasing exponential, starting at $V_+ = 2.88 \times 0.34 = 0.98$

- What is $V_o$ at $t = 3.5\, \text{ms}$?
  \[ V_+(3.5) = 0.98e^{-\Delta t/\tau} = 0.085 \]
The op-amp is ideal, with $V_{CC} = 10\, \text{V}$ and $V_{EE} = -10\, \text{V}$.

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
- What is $V_o$ at $t = 3.2\, \text{ms}$?

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All voltages in mV

- Sketch the input $V_+$ as a function of the voltage input $V_i$.
  $V_+$ is the voltage-divider output from $V_i$.
  $V_+ = [3.6/(3.6 + 23.4)]\, V_o = 0.133V_o$
  Thus, output goes from $V_+ = 0.133 \times 20.61 = 2.74$ to $V_+ = 0.133 \times 61.34 = 8.16$

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  Gain, $G = G = 1 + (1200 \parallel 1200)/31 = 20.35$
  Thus, output goes from $V_o = 0.133 \times 20.61 \times G = 55.8$ to $V_o = 0.133 \times 61.34 \times G = 166.0$

- What is $V_o$ at $t = 3.2\, \text{ms}$?
  $V_o = 0.133 \times 61.34 \times G = 166.0$
The op-amp is ideal, with $V_{CC} = 15 \text{ V}$ and $V_{EE} = -15 \text{ V}$.
Input $V_A = -5 \text{ mV}$ (constant over time).

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
- What is $V_o$ at $t = 3.2 \text{ ms}$?

All voltages in mV

- Sketch the output $V_o$ as a function of the voltage input $V_i$. (label times and voltages)
  
  This is an added circuit
  
  $$V_o = - \left( \frac{1200}{3.5} V_A + \frac{1200}{25} V_B \right) = -(342.9V_A + 48.0V_B)$$

  Thus, the output goes from
  
  $V_o = -[342.9(-5) + 48.0(24)] = 562 = 0.56 \text{ V}$ to
  
  $V_o = -[342.9(-5) + 48.0(18)] = 850 = 0.85 \text{ V}$

  **Test:** Is $V_o \geq V_{CC}$ or $V_o \leq V_{EE}$?

- What is $V_o$ at $t = 3.2 \text{ ms}$?
  
  $V_o = -(342.9(-5) + 48.0(18)) = 850 = 0.85 \text{ V}$